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PALEONTOLOGY.—*The role of the individual in evolution.*[1]

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"All is for individuals."[2]

Whatever happens in organic evolution, or indeed within the whole realm of the biological sciences, happens to an individual. Genetic mutations occur in individuals. Individuals struggle for existence and fail or succeed according to their equipment and circumstances. It is individuals that reproduce and that exercise such selection of a mate as may be possible to them. These facts are so evident that it may not seem worth while to state them, and similar statements so exhaust the basic aspects of evolutionary theory that it may seem impossible to say more about the role of the individual in evolution. Nevertheless such statements of the obvious are not needless, because the obvious is so often forgotten, nor do they exhaust the subject, because it has scientific, philosophical, and social ramifications that are both subtle and complex.

Difficulty is encountered at the outset in attempts to define an individual. I am sure that I am an individual, and I am willing to grant the same status to a dog, an oyster, or a pine tree. This apparently simple concept, however, begins to encounter difficulties if a colonial coral is considered and to break down altogether on the problem of whether a lymphocyte is an individual. There are different categories of individuals and different degrees of individuality. Their classification and definition could be discussed for hours, and the discussion would probably produce more obscurity than light. Let us avoid this confusion by using the word "individual" in a commonplace sense as an organically continuous living structure capable of reacting independently and as a whole.

There has been evolution toward more and toward less individual-

[1] Address delivered before the Paleontological Society of Washington, November 20, 1940. Received November 30, 1940.

[2] The section epigraphs are all from Walt Whitman's poem "As I Sat Alone by Blue Ontario's Shores."

ity. A solitary protozoan, such as an amoeba, is fully individual under our definition, but one cell of a protozoan colony, as in *Volvox*, is less individual. As metazoans arise by cellular differentiation, the protozoan individuality of the single cell is effectively lost, and the metazoan structure becomes itself fully individual in the same sense as the solitary protozoan but on a new and different level. In colonies of essentially similar but organically continuous metazoans, as in many corals, the metazoan individuality begins to merge into one of different level. Finally a stage may be reached, as in *Physalia* and its allies, in which the united metazoan zooids are differentiated in function and structure and have almost entirely abdicated their individualities in favor of what might be called a hyperzoan individuality. Here there appears to be a true emergence of individuality belonging to the colony rather than to the zooids, in the same way that metazoan individuality belongs to the animal and not to its constituent cells.

Hyperzoan individuality is a rare evolutionary development. The vast majority of living things have stopped short at the metazoan level, and their further progressive evolution has been an intensification of individual integration and complication on that level. This is preëminently true of the vertebrates and among them of the line leading to man, which has shown neither the trend nor the potentiality of developing hyperzoan individuality. Certain social groups, particularly among insects, present evident analogies with hyperzoan individuals, and there has been a strong recent tendency to consider human society as possessing this sort of individuality, but in a biological sense this is wholly false except as a figure of speech. One level of individuality can arise only to the degree that the subordinate level is suppressed. Most animal and all human social groups are collectivities the members of which retain complete metazoan individuality.

This distinction between group and individual is fundamental and has implications of the greatest importance, extending even into the political sphere. The subject will be developed further in the following pages, and these implications will be explored when a broader basis for them has been laid.

THE INDIVIDUAL, DARWINISM, AND GENETICS

"For the great idea, the idea of perfect and free individuals."

In a Lamarckian view of evolution, the individual is all-important. He is the master of his fate in the broadest sense, and individual activities may wholly determine the course of evolution. The individual acts, learns, and strives; his characteristics are thereby altered, and

some part of this modification is transmitted to the next generation. This theory dies hard, and paleontologists seem inclined to cling to some aspects of it more than neobiologists, but it probably must be abandoned. No means for the transmission of such individually acquired modifications have been discovered, and long experimentation has failed to reveal unquestionable evidence of its real occurrence. It now appears that new characters can arise only in the germ plasm and that their rise is little or not influenced by any purely individual factor.

Under more strictly Darwinian theories and the genetic theories that partly supplement and partly supplant Darwinism, new characters in phylogeny arise at random, at least in the sense that their appearance is sporadic and that the present state of our knowledge does not enable us to predict them individually. The individual seems at first sight to have little to do with evolution under these circumstances, which make the emergence of novelty seem as impersonal as the fatality of a bolt of lightning striking a crowd. It may be only ignorance that makes us think that this is true, but even if it be granted, the individual is still left an essential role in evolutionary theory. The fate of mutations and their genetic combination and segregation are aspects of evolution quite as important as their origin and more approachable, and here the individual is highly important.

The Darwinian theory of natural selection is often presented as primarily a pruning process. Given the fact that hereditary variation occurs, whatever its basis and origin, this viewpoint is that the direction of evolution is largely controlled by negative factors: by the elimination of some variations, singly or in combination. Even those geneticists who are least neo-Darwinian usually recognize selective elimination as one crucial factor in evolution. Here the individual's role is stellar but tragic. His essential part in evolution is to die. If selection is operative, death is not a random occurrence in which the individual counts for nothing, but must be correlated with individual characteristics and the study of the selective process must be directed toward individuals.

Some individuals are always less fit than others, or carry genes that are deleterious under the environmental conditions available to the species. As Dobzhansky says, "It is the loss of these individuals that guards the species as a whole from extinction." And he adds, "The general picture of the mechanism of evolution thus arrived at will certainly be far from pleasing to those who regard nature as an embodiment of kindness. The writer must confess that this picture is

not pleasing to him either. The words 'good' or 'bad' are not to be found, however, in the scientific lexicon."

The selective process, however, is not concerned with elimination only, and gloomy concentration on the death of the individual and the extinction of the species leaves out what Darwin himself so well emphasized as the essence of natural selection, that is, the survival of the fittest. It is no truer to say that the individual's role is to die than to say that its role is to survive. The species is a sum or collectivity of individuals, and it is an entity only in this sense, not in the sense of having a sort of superindividuality. Its survival similarly is the sum of individual survivals. Survival, along with reproduction, which is an aspect of survival, is the individual's business.

The individual's role here, one might say his duty if the word can be used without anthropomorphic implications, may be represented in terms of striving to obtain satisfaction. On the lowest level, active bodily metabolism and reproduction have come to be basic satisfactions, simply because they do have this survival value. It may be objected that satisfaction is an emotion and that the vast majority of living organisms feel no such thing, but the difficulty is semasiological rather than conceptual. In every living thing there is at least an impulsion or need that is eased by such fulfillment, and satisfaction is as good a word as any to use for this phenomenon. The connotation is not necessarily emotional any more than in saying that a certain value of x "satisfies" an equation. It is legitimate to speak of a tree, for instance, as satisfied by maintaining its organism in the vital state and by producing fertile seeds. On the higher animal levels these biological satisfactions, although fundamentally the same, tend to become conscious and finally do acquire truly emotional value.

From this point of view, it can be said that the species prospers to (and only to) the extent that individuals attain satisfaction, and that the species is modified because some heritable characteristics assist more than others in the striving for individual satisfaction. The nature of the satisfactions operative within a given species is also heritable and subject to evolution. This appears to be quite the opposite of the view that the greatest thing individuals do for a species is to die, for death is the antithesis of individual satisfaction. Some may declare with Tennyson that nature (or evolution) does not really act this way,

> *So careful of the type she seems,*
> *So careless of the single life.*

Entomologists may insist that social insects habitually behave for

the good of the group and not for individual satisfaction, and some sociologists maintain that the sacrifice of individual satisfaction is the highest human trait and the only hope for human progress. It is, I think, a mistake to suppose either that insects do or that humans should prefer group satisfaction to individual satisfaction. The apparent anomaly is explicable by the fact that two distinct broad categories of individual satisfaction have survival value. In one case the satisfaction lies in belonging to and serving the group. It arises in the individual but as the result of an extrinsic or environmental situation.

Mutations tending to make individuals prefer extrinsic to intrinsic satisfaction have been called altruistic, for instance by Haldane, who has studied them from a neo-Darwinian genetic point of view. As Haldane has pointed out, however, what we call altruism in man frequently is not altruistic in this biological sense, nor is such biological "altruism" necessarily eugenic and its opposite dysgenic. The biological factor is not forgetfulness of self in service to others, negation of the individual, as altruism is supposed to be, but is self-satisfaction on an individual basis by means which do, as result rather than intention, tend to sacrifice the individual to the group.

Genetic emphasis on extrinsic satisfaction is unlikely to arise in large or in cross-breeding groups, and it is unlikely to have survival value for the species unless it is confined to one caste, like the neuters among social insects, while another caste, like the queens among these insects, is dominated by intrinsic satisfactions. A species in which only extrinsic factors gave individual satisfaction would be doomed to almost immediate extinction under any ordinary conditions and such a species probably could not arise. On the other hand, individuals dominated by intrinsic satisfaction, or belonging to species in the evolution of which this has the major survival value, frequently also experience extrinsic satisfactions and the conflicts and coordinations of the two give rise to some of the most elaborate forms of behavior and to some of the most complex evolutionary developments, including those of men.

In another respect the individual is a fundamental factor in the fate of genetic modifications once these have arisen. The spread of a mutation through a species (or interbreeding group), its survival or extinction, its equilibrium point, and its combination with its various allelomorphs are all functions of the number of individuals comprising the group, as has been well demonstrated by Wright, Fisher, and Haldane, among others. This aspect of the subject is somewhat aside

from the main theme of the present discussion, but in passing it is desirable to emphasize one point, familiar to geneticists but less so to paleontologists, whom it most directly concerns.

Rapid evolution and evolution involving complex new structures or fundamental reorganizations of structure depend on many factors. Some of these factors are still quite unknown, but it seems certain that the number of interbreeding individuals is one of them. It is theoretically probable and as far as observation is possible it appears to be the fact that large groups of individuals evolve relatively slowly and are less likely than smaller groups to develop any fundamental structural changes. If a paleontologist has a large number of specimens of a given group, this is usually in itself evidence that the group, when alive, was rich in individuals. Such groups do, of course, give legitimate evidence of some of the modes of evolution, but these modes may be quite different both quantitatively and qualitatively from those of groups that included fewer individuals and that are therefore rare or absent in paleontological collections. It is, then, necessary to be cautious in generalizing from such groups as the known fossil horses. It is probable that "laws of evolution" deduced from this series do not apply to the individually less abundant (and in this case still quite unknown) animals that first acquired the basic perissodactyl structures. This numerical factor may be the real reason for many of the sudden breaks and supposed leaps in the paleontological record, often explained in very different ways. It is almost surely the reason why many paleontologists have believed that evolution normally progresses with great regularity and in straight lines.

THE INDIVIDUAL AND EVOLUTIONARY FATALISM

"We are executive in ourselves—We are sufficient in the variety of ourselves."

Whatever the personal philosophy of the student, the usual approach to the practical study of evolution has been deterministic and mechanistic, or physical in a sense that has been abandoned by many physicists. In its extreme expression, as developed by some nineteenth century workers, this attitude is that if the distribution and state of all the matter and energy in the universe at a given instant were known and if all the immutable physical laws of causation were likewise known, then everything that would ever occur after that instant could theoretically be predicted. This stern creed is emotionally distasteful to most men, and it involves a number of serious logical and philosophical difficulties. It has been subject to repeated attack, and in various spheres there has been a strong reaction against it.

As far as these attacks have originated in theology, in vulgar misapprehension, or solely in emotionalism they do not concern us here, but in many cases they have been led by scientists and have taken the form of alternative scientific theories. In the physical sciences determinism has tended to give way to "uncertainty relations" and to a so-called statistical view of natural law. Some physicists have strayed so far from the field of the determinate and the classically mechanical that they have imagined themselves face to face with God and have set up as scientific theologians, as which they cut rather sorry figures.

In the biological sciences a somewhat similar position has been reached by different paths. Life activities are superficially so unlike most inorganic activities that it is tempting to think of life as something fundamentally nonmechanical. From this it is an easy step to the conviction that the essence of life, its real distinction from the nonliving, does not reside in any feature of physical organization but in something nonphysical or metaphysical. So the biologist reaches a conclusion suggestive of the theological distinction of body and soul, although he demands his own definition of "soul" and generally refuses to give it that name. If this distinction is valid, then there is no reason for believing that evolution and the life processes in general are mechanical sequences, and it is possible to maintain that they are modified or controlled by impalpable forces without any material basis or directly material manifestation. One eminent paleontologist has endowed these forces with some degree of personality and seriously maintains that evolution has been directed by spirits of limited intelligence and diverse intentions. This miscegenation of modern science and medieval demonology is perhaps the most extraordinary recent development of scientific philosophy, but it is an extreme, not wholly illogical, toward which much recent biological thought tends.

A related line of development of evolutionary theory has in some respects been curiously opposite to the drift of physical theory from determinism to indeterminism. A basic premise of Darwinian evolution was the existence of random variation. A more recent school of thought insists that random variations (even if heritable) have had little or no significance in evolutionary history and that evolution has followed definite predetermined and theoretically predictable lines regardless of random fluctuation. Such a descriptive theory of the course of evolution is capable of a mechanistic or even of a purely Darwinian causal explanation, but as it has been most energetically advanced (especially by Osborn) it is essentially metaphysical. When the conception of a goal is added, this metaphysical basis becomes still more evident,

and the extreme is reached with teleological judgments of the goodness or badness of mutations.

These two broad trends of thought, one maintaining that causation in evolution may be largely nonphysical and the other that evolution is a continuous, nonfluctuating sequence with a predetermined outcome, contrast in many ways but they are compatible (frequently being combined in the theoretical conclusions of a single student) and they are alike in this: that they lead to a sort of evolutionary fatalism. They reject the conclusion of Darwinism and of various other theories that the products of evolution are the results of a sequence of accidents—not accidents in the sense of things happening entirely at random but in the sense of occurrences mechanically produced by complex concatenations of circumstances, not intended and not foreordained and subject to change of direction with any change in the circumstances. In the place of this concept, the adherents of entelechy, aristogenesis, and the like maintain that evolution consists of progression toward some ideal. They feel that the products of evolution were intended, in some metaphysical sense, and they replace accident by fate.

The bearing of these philosophical considerations on the role of the individual in evolution is direct and crucial. It has been shown that under the Darwinian and the usual genetic theories, the activities and satisfactions of the individual are determining factors in the course of evolution. According to the theories of evolutionary fatalism, on the other hand, the individual does not matter unless, possibly, to himself. The direction and rate of evolution should be independent of individual factors. The transition from *Eohippus* in the Eocene to *Equus* in the Recent is considered as an orthogenetic inevitability, and all that the myriads of individuals in the sequence had to do with it was to exhibit the structures involved and to produce the succeeding generations. The same attitude toward the individual arises, *a fortiori*, in the still more metaphysical theories that assume a universal organizing force, a sort of world-soul, or spiritual guides and innovators.

As purely philosophical problems, these questions are as complex and as nearly insoluble as the question of free will, and their discussion on that basis would be as futile. As scientific theory, I find that I have here called fatalistic evolution quite untenable. Its strongest evidence has been drawn from the field with which I am most familiar and is seen in the phenomenon commonly called orthogenesis. As straight verbal description of what has happened in a few particular instances, orthogenesis and similar paleontological inferences are valid and use-

ful. As theoretical generalizations of the mode of evolution, and still more as bases for metaphysical speculation on the causes of evolution, they are not valid, or at least not in the sense of justifying fatalistic placing of the individual in the scheme of things. The lines that give evidence of orthogenesis are all individually abundant groups, regarding which necessary caution has already been enjoined. The structural changes involved are all genetically very simple in comparison with those involved in the major events of evolutionary history. They can be well explained in purely mechanistic genetic terms, with no recourse to orthogenesis in any metaphysical sense.

The individual is a pawn of fate only to the extent that his inheritance is not and his environment is only in part of his own making. These come to him as a result of past causes, not as presage of future destiny. Within this framework, so largely wrought by the actions and interactions of previous individuals in the enormous web of life, the individual makes his own fate and that of the species composed of him and his fellows.

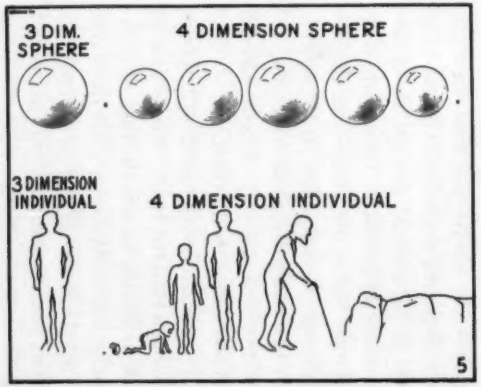
THE INDIVIDUAL AND THE FOURTH DIMENSION

"I swear nothing is good that ignores individuals."

Among the most significant trends in zoology and paleontology are the increasing use of dynamic concepts and study of dynamic problems. The most limited and formerly the most common sort of work in these fields consisted of the examination and comparison of a supposedly representative, dead individual of any given species. The zoologist studied animals that had been dead for a few months or years and the paleontologist studied animals that had been dead for hundreds of thousands or millions of years: the technique is different, in part, but the approach is the same. Now both zoologists and paleontologists, each in the ways permitted by their materials, are more likely to study animals as functional, active organisms and not only as static morphological exhibits. This shift in emphasis has given rise to a new concept of the individual and to a new orientation of the individual in the scheme of things.

The dynamic concept of the individual is four-dimensional. An individual is not a certain combination of tissues arrested at a moment in time, but is the whole sequence of states and forms through which one animal passes from the fertilized ovum to death. That this seemingly obvious fact really represented a new viewpoint in the biological sciences is shown by the radical changes brought about by it in the recapitulation theory during the past 20 years. Although based on the

PROTOZOAN INDIVIDUAL
GOING
GONE!
METAZOAN INDIVIDUAL
GOING
GONE!
HYPERZOAN INDIVIDUAL
HIERARCHY OF INDIVIDUALITY
1
NEGATIVE POSITIVE
NATURAL SELECTION
2
EXTRINSIC INTRINSIC
SATISFACTIONS
3
GOAL
FATED DIRECTION
START
ORTHOGENESIS
RESULT
SELECTIVE TREND
START
RANDOM VARIATION
4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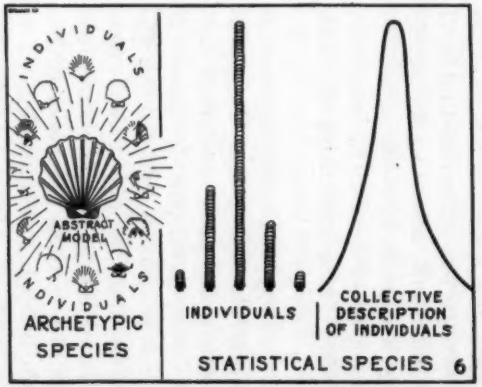
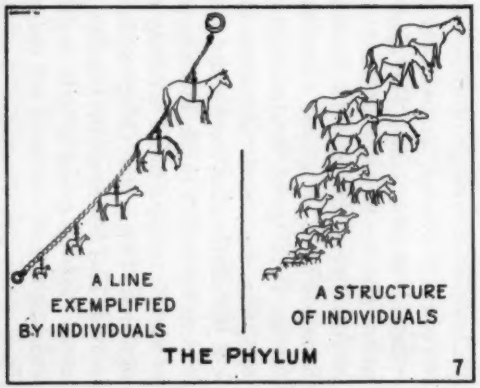
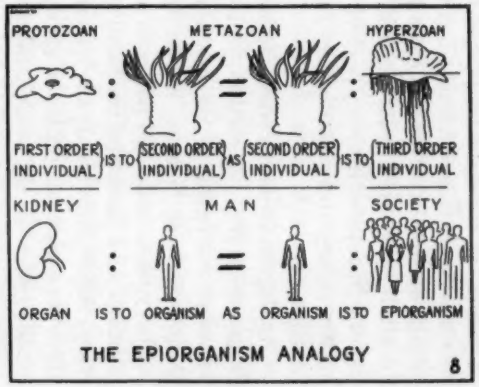

INDIVIDUALS
ABSTRACT MODEL
INDIVIDUALS
ARCHETYPIC SPECIES
INDIVIDUALS
COLLECTIVE DESCRIPTION OF INDIVIDUALS
STATISTICAL SPECIES 6


A LINE EXEMPLIFIED BY INDIVIDUALS
A STRUCTURE OF INDIVIDUALS
THE PHYLUM 7


PROTOZOAN
METAZOAN
HYPERZOAN
FIRST ORDER INDIVIDUAL IS TO SECOND ORDER INDIVIDUAL AS SECOND ORDER INDIVIDUAL IS TO THIRD ORDER INDIVIDUAL
KIDNEY
MAN
SOCIETY
ORGAN IS TO ORGANISM AS ORGANISM IS TO EPIORGANISM
THE EPIORGANISM ANALOGY 8

superficially dynamic idea of a succession of structural stages, Haeckel's so-called biogenetic law was fundamentally static. It really conceived of the individual as a motionless and timeless adult structure and achieved the illusion of motion (like a moving picture) by a succession of stills. Garstang has shown the true nature and limits of recapitulation in terms of a dynamic individual, inheriting not merely its adult structure but its whole life cycle from its ancestors and showing modifications in every part of that cycle effected by the same sort of hereditary and evolutionary factors as those influencing the final, static form.

Analogous dynamic concepts have been applied in the consideration of groups and of the relationships of individuals to groups. The philosophical zoologists of the late eighteenth and early nineteenth centuries, such as Goethe, Oken, and Owen, developed the theory of archetypes as ordained patterns more or less closely followed by individuals. As a thousand freehand sketches from the same model would vary, so do individuals vary from the archetype, but the variations have no significance for the study of the essential, the philosophical reality, which is the model and not the individual sketch of it.

The spread of evolutionary zoology led to the abandonment of the philosophical concept of archetypes, but the static point of view involved in it was not immediately discarded and indeed persists to considerable degree today. The diagnosis of taxonomic groups by statement of a combination of fixed characters believed to be common to all members of the group is almost exactly the same process as the delineation of an archetype, however different in intention and interpretation. It relegates the individual to the same insignificant role, attempting, not the simultaneous description of a group of individuals, but the abstraction from them of all that is not individual.

A newer and, I think, incomparably truer and more profitable point of view is making rapid headway although still far from universal recognition. This is that the group is best definable as a collection of individuals and not as an abstraction of the nonindividual. This does not mean that the group is to be defined on the basis of one or a few individuals, a fault rather of the old, static, pseudo-archetypal taxonomy than of the new, dynamic, statistical taxonomy. On the contrary, full definition in the newer sense requires the examination and use of more individuals. If only one is available, the group definition or concept derived from it must be more loosely drawn; the unique specimen is not an example of an archetype but one of a collectivity of individuals

and due allowance must be made for the probable varying characteristics of the unknown individuals of the group.

According to this concept, the differences between individuals are as much characters of the group as are their resemblances and may be more important from an evolutionary point of view. The "characters in common" of static group concepts are replaced by determinations of central tendency and importantly supplemented by the study of dispersion. These concepts are essentially statistical, although it would be dangerous to give them that name before an audience inadequately acquainted with them. Some zoologists still think of statistics as a rather mysterious and very complicated mathematical game played with long lists of measurements. Statistical concepts, as the term is used here, involve a point of view that may be quite as pertinent to one observation as to a thousand and to a purely qualitative character as to a measurement.

It may be said that the statistical procedure is to describe the group as such rather than in terms of the individual, and it is superficially paradoxical to say that this restores the individual to the basic and essential position denied it in the older group concept, which often was expressed in terms of the individual. The paradox is, however, easily resolved. The statistical group concept seeks to take into account all the characteristics of all the individuals of the group, while reducing their description to collective terms. The archetypal group concept seeks to eliminate all characteristics by which individuals are distinguished, even though it may describe the residuum in individual terms.

Especially in the hands of paleontologists (although not yet by all of them), group concepts are also coming to have a fourth dimension analogous to the four-dimensional concept of the individual. To nonevolutionary zoologists, the archetype was divinely ordained and immutable except by subsequent divine renovation. The archetype-like group definitions of evolutionary zoologists had, of course, to be mutable, but the expression of phylogeny was really a succession of static pictures, like the Haeckelian concept of ontogeny. A phylum in time was recognized and defined primarily in terms of the common characters of all its species, just as the species was discussed in terms of the common characters of its individuals. But the particular sorts of groups to which the name phylum may be applied in a general sense include a time dimension. The secular changes that occur in them are as essential and characteristic as are their common or immutable features, and from an evolutionary point of view considerably more

important. Thus the concept of a phylum (or of any taxonomic group with perceptible extension in time) becomes dynamic, and it is better defined in terms of the changes that occur within it than in terms of its constant differences from other groups.

For the present subject the most important conclusion from this dynamic approach to taxonomy and phylogeny is corroboration and extension of the conclusions already drawn from evolutionary theory. The group is not an entity in the sense that the individual is an entity. A group achieves adaptation and progresses only in the sense that the individuals composing it do so. Satisfaction is an individual compulsion and not a group achievement. Evolution is not a thread on which individuals are strung, but a structure composed of individuals. A species is not a model to which individuals are referred as more or less perfect reproductions, but a defined field of varying individuals. A phylum is not a supermodel that abstracts the immutable features of a group of specific models, but a flowing river of ever-changing individuals.

THE INDIVIDUAL AND TOTALITARIANISM

"The only government is that which makes a minute of individuals."

"There arises a four-dimensional picture of the totality of life, with time as the fourth dimension, just as the individual gradually develops by growth from one cell all the organs that finally compose the complete body. The organs do not arise at random, but in the frame of the whole and some also degenerate before the whole body reaches maturity. In the development of the individual which in turn is only a subordinate part of the totality, an item is dominated by the unity of the whole, and in the same way the general evolution of life also exhibits a higher level of organization, an organic course of life."

"And now a final word about the future of society, the further evolution of the epiorganism. Unless the consistent indications of a great range of biological knowledge are all erroneous, the epiorganism will move toward increasing integration. . . . Units will become more specialized and interdependent, present epiorgans will improve in function and new ones will appear. The individual will be more and more a part of the whole state, though it will remain meaningless to ask the question, 'Does the citizen exist for the state or the state for the citizen,' since reciprocal influence is the essence of an org."

These passages were published at about the same time, in 1940, the first by a great German paleontologist, F. von Huene, and the second by a great American physiologist, R. W. Gerard. Both men, like others

before them, are comparing the individual within his society or group and an organ within the individual. Converging on this end from different directions, both reach the conclusion that the individual is part of a higher organism in the same sense that a cell or an organ is part of an individual. Both at least imply the proposition that the welfare of the higher organism, the epiorganism of Gerard, is of paramount importance in evolution and that the individual is to be viewed primarily as a subordinate unit. As far as his scientific work shows, the German quoted is as nonpolitical as one can be in Nazi Germany, and the American is outspokenly anti-Nazi, but the conclusions of both are sound totalitarian ideology. The question arises whether these conclusions are also sound biology, and in the world today consideration of the role of the individual in evolution can have no greater human value than by answering this question.

The transfer of knowledge and of judgment from one field to another is notoriously difficult, and one need not look far to find men eminent in one field who have made themselves ridiculous by posing as oracles in another. The biologist as sociologist, still more as political prophet or propagandist, runs a similar risk, but we are all necessarily concerned with social evolution. Whether or not they are really pertinent, biological theories are being used in this field, and the biologist necessarily has a part in the discussion, if only as critic.

The physical sciences have been accused of providing the material resources of war and oppression and their students have lately been on the defensive and most vociferous in endeavors to prove the accusation unjust. Now the biological sciences are being used to provide the more insidious and still more menacing moral implementation of totalitarianism. If this use is wrong, scientifically, and if free biologists support it or even tacitly permit it, then they will deserve an accusation stronger than any that can be brought against physical science and they will be contributing to their own destruction.

The analogy between the individual and society, or between organism and epiorganism (an *a posteriori* terminology that assumes the full validity of the analogy), is very old. Everyone has heard it, and most of us have used it as a figure of speech. When it ceases to be a figure of speech and becomes a basis for advice and action, it enters a new and more dangerous sphere and becomes subject to more critical examination and limitation. In this extended form the reasoning runs as follows: Cells and organs compose an individual. Individuals compose a society. The functional relationships of part to whole are analogous in the two cases. The evolutionary principles involved in the

integration of cells and organs into complicated individuals of increasingly higher type can and should be transferred to the political field as guides for the evolution of increasingly complex and higher types of society.

The biologist who accepts this argument soon finds that he is envisioning, perhaps even recommending, a society in which the individual is a specialized organ in a superindividual organism, in which, indeed, he is not an individual in the usual sense. The evolutionary analogy suggests to him that the epiorganism will and should evolve in the direction of greater integration (i.e., less individual freedom and responsibility), and that its units (i.e., you and I) should become more specialized (with less scope for activity and change), more interdependent (less self-reliant), and more a part of the whole state (less individual). (These conclusions, exept for the parenthetical expressions, are paraphrased from Gerard). Then the biologist finds himself face to face with the fact that this is the totalitarian ideal. Of course, the politically totalitarian biologists accept the conclusion gladly and are strengthened and comforted by it. If, however, a biologist happens not to be politically totalitarian, he is likely to be shocked and to look for a way of avoiding his own conclusion.

The most obvious escape from this dilemma is to decide that totalitarianism is good or "basically progressive," as Gerard says, but that Nazism, for instance, is bad totalitarianism. The point is important enough to warrant brief examination of the more essential arguments given by Gerard and others.

Democracies are said also to be progressing toward integration, but aside from this general direction to be doing so in a biologically eugenic way while the existing totalitarian states are advancing in a dysgenic direction. That democracies are advancing toward integration in a totalitarian sense, except as they may be moving toward actual totalitarianism (for better or for worse), is open to question. Even supposing it true, their integration is different both in degree and in kind from an epiorganic structure. It is not at all in the direction of what I have called hyperzoan individuality and it is not totalitarian according to current ideologies.

The wrongness of direction of the existing totalitarian states is said to be shown by overspecialization, by isolation, by reversion to rule of force, and by deliberate excision of episense organs. That the direction is wrong I most heartily agree, but these arguments are so easily refuted, if their analogical basis be granted, that they can only comfort the nations that they are meant to confound. Gerard gives the saber-

tooth tiger and the king-crab as analogies for overspecialization and as evidence that the Nazi epiorganism is doomed to extinction. The sabertooth specialization was, in fact, one of the most successful ever developed by a mammal. The machairodonts maintained their high level of specialization for conflict over a period of at least 30,000,000 years. True, they are extinct now, but the most probable reason for their ultimate extinction was the extinction of their accustomed prey. The analogy certainly does not favor the democracies! The king-crab is a worse example. This group has survived almost unchanged since the Triassic and is thriving now. Far from dooming it to extinction, its specializations seem almost to be a recipe for group immortality. But the example really has nothing to do with the case, because the totalitarian nations unfortunately are not withdrawing into a figurative shell.

As regards isolation, the argument seems to be going off at a tangent, because this does not really involve the organism-epiorganism analogy on which the rest of these conclusions are based. Moreover, it is not the totalitarian nations that are tending toward isolation in an evolutionary sense. Quite the contrary. They are the exponents and the present practitioners of expansion, migration, conquest of hostile environments, and competition with other epiorganisms—the very sort of activities that have produced the most potent and successful organisms in biological evolution. It is our own democratic country that shows a tendency toward isolation, the biological analogue of which has dysgenic results.

The integration of an organism is necessarily one of compulsion. What higher organism could function if a muscle reacted by its own free consent? Integration is only achieved by the fact that a muscle must react when told to and can have no choice in the matter. If society should be integrated in these organic terms, it is therefore meaningless to say that rule by force is bad. On these premises, it is not only inevitable and necessary but also biologically good. A truly integrated epiorganism can only function by force.

By the excision of episense organs, Gerard means ideological limitation and official control of scientific and other intellectual activities. But from the totalitarian point of view there is no excision in this but only integration. The totalitarians can and do use the same analogy to demonstrate that they are not gouging out the eyes but are only making them focus and direct themselves in accordance with the will and needs of the whole organism. In an integrated organism there can not be any individual freedom of the parts. Only a diseased eye looks

where it will rather than where it is told to look. So in a perfect totalitarian epiorganism there should be neither freedom of action nor of thought, except in the unique leader, for these are symptoms of epiorganic disease. The biologist may conclude that he and his fellows should be the directive organs of the epiorganism and that the lesser breeds then do not need any freedom of thought or action, but experience shows that an epiorganism is more likely to differentiate its brains from housepainter-tissue than from scientist-tissue, and there is no evidence that the results would be very different in either case.

If totalitarianism is good, in itself, I see no escape from the conclusion that the present totalitarian states of Europe are fundamentally good and are on the best course of human evolution, whatever mistakes they may make on the way. (Democracies are not characterized by inability to make mistakes.) The organism-epiorganism analogy does logically and inevitably commend basic structures and principles of the states, whether Nazi, communist, fascist, or shinto, that accept totalitarian theories or practices. The democratic biologist who adopts this analogy in all its extension has no valid escape from the dilemma and no logical choice but to shift his allegiance.

The other alternative is to recognize that this use of the analogy is completely unsound. The relationship of the individual to society is fundamentally unlike that of the organ to the individual. The two relationships involve entirely different orders of things and do not belong in the same field of thought. As well say that electrons and their fellow particles compose silver, that silver analogously composes a photographic image, and then criticize the photograph because its pictorial composition is unlike the organization of a silver molecule. It is obvious that an individual is not an organ of society in the sense that a liver is an organ of an individual, but the very boldness of the metaphor and its wide applicability have made intelligent men forget that it is only a metaphor.

Such analogies are valid only as far as the two terms are well known and their analogical relationship is a matter of observation. Thus far they have descriptive value, but they warrant no extension to inferences beyond the field of observation. They have no predictive value and they do not permit transfer of knowledge and principles from one field to another. The biologist who elevates the organism-epiorganism metaphor into a standard for social interpretation and recommendation is guilty of the most reckless, unjustified, and nonscientific extrapolation.

A hyperzoan individuality, such as was mentioned in the introduc-

tory remarks, does not and can not possibly exist among mankind. A social group has no individuality according to the biological concept of the individual, and the extension to it of the same term is more likely to be confusing than enlightening. While exploring the analogy at least to, and I think somewhat beyond, the full extent of its validity, Julian Huxley has noted this essential limitation. "But," he wrote in the same journal as Gerard (Scientific Monthly) and in the same year (1940), "whereas the individuality of the body of a higher animal, cuttlefish, insect or vertebrate is far more developed than that of its constituent cells, that of a human society is far less so than that of its individual units. This fact, while it makes the analogy between cell and human individual almost worthless, is of great value itself as a biological analogy, since it immediately exposes the fallacy of all social theories, like those of Fascism and National Socialism, which exalt the state above the individual."

There is a true biological-sociological analogy, in part a true homology, and that is between the relationship of the individual to the evolution of species and to the evolution of social groups. I have failed in my purpose if the bearing of this analogy on the present state of human affairs is not now becoming clear. The group is a collectivity of individuals. It has no entity except as derived from the relationships of individuals. It does not evolve except as individuals change. It does not prosper except as individuals prosper, and it is incapable of satisfaction but is modified and perpetuated by individual desires and attainments of satisfactions.

The integration that has been progressive in evolution, that has led to higher types of life and that has been "good" biologically, or eugenic, has been integration of the individual. The ability of the individual to function freely, and in increasingly complex and varied ways has had survival value and has been progressive. Development of individual dependence and loss of individual versatility have usually been degenerative. In the line leading to man, the ability to form and to manage complex social structures has certainly followed the development of ever greater individual capacities and adaptability and, socially, a growing awareness of the rights of other individuals, which is the opposite of social subordination of individuals.

In this evolution it is clear that intrinsic satisfactions, as I have defined them on a previous page, have been dominant although extrinsic satisfactions have also played an important part. In addition to the profound error of supposing satisfaction to affect groups in a way different from the sum of the satisfactions of the individuals compos-

ing the groups, it is a characteristic of the totalitarian nations to emphasize extrinsic individual satisfactions at the expense of intrinsic. This is opposite to the emphasis that led to human evolution, physical and social, and if successful it seems biologically probable that it would lead not to a continuation of evolution to higher human levels but to a change of direction from human to nonhuman. The end of that different direction is exemplified for us by the social insects. I doubt whether even the most rabid myrmecophiles really want to live in a society patterned along those lines. In fact, it seems biologically impossible that the experiment can succeed, simply because we are mammals and were evolved as we were. We have neither the inheritance nor the genetic potentiality for making extrinsic satisfactions superior to intrinsic in survival value.

Biological justification for the totalitarian development of society has also been sought in the doctrines of evolutionary fatalism. Regardless of such labels as "right," "wrong," "good," or "bad," it is argued, this is the inevitable future. Mankind is going this way just as horsekind was going toward *Equus* throughout the Tertiary. Opposition is as futile and foolish as if the little *Eohippus* had said, "I am going to be a dinosaur," instead of "—a horse."

Even aside from the fact that this is another false use of analogy, it has been shown that a fatalistic view of evolution has little scientific support. It is not a probable hypothesis, still less a necessary one. A poet like Mrs. Lindbergh may urge submission to "the wave of the future," but a scientist may still believe that we are making our own future and that we have the capacity to make it to our liking and for the good of all of us as individuals.

The essence of democracy is belief in the importance and independence of the individual, and in the progress of society through the satisfactions of the individuals composing it. The essence of totalitarianism is belief in the unimportance of the individual and his subordination to the state, and in the progress of society as a thing in itself regardless of the satisfactions of the individuals in it. I believe with all my heart and head that the democratic principles are biologically sound and humanly eugenic, the totalitarian principles unsound and dysgenic. I believe that it is our duty, not as citizens of a democracy but as among the dwindling number of citizens of the world still privileged to live and think as individuals, to oppose the totalitarian fallacy and to maintain the true place of the individual in our social and in our biological philosophy.

PALEONTOLOGY.—*Ostracoda from the Devonian (Onondaga) chert of west Tennessee.*[1] R. S. BASSLER, U. S. National Museum.

In the vicinity of Camden, Benton County, Tenn., along the line of the N. C. & St. L. Railroad, are large quarries exposing the Devonian formation that J. M. Safford and Charles Schuchert in 1899[2] described as the Camden chert of Lower Oriskany age, judging from the macrofossils. Then, as outlined in Miss Wilmarth's *Lexicon of Geologic Names of the United States*,[3] Professor Dunbar in 1918[4] restricted the term Camden chert to the upper 200 feet of the original formation, which he determined as of Onondaga age, and subdivided the lower part into the Harriman chert (0–55 feet thick) underlain by the Quall limestone (0–10 feet thick), both of Oriskany age, and at the base, the Decaturville chert (0–6 feet thick) of Helderbergian age. The ostracod fauna here described from the true Camden chert is of special interest for the beauty of the specimens and the unusual way in which they have been preserved. Only the strongly marked species are here described; the smooth forms remain for some future work.

The cherty beds of the Camden as well as most other chert formations were originally limestones that during long weathering had been replaced by silica. In the resulting cherts the fossils are usually represented by molds or by an internal cast separated by a space from the wall of the mold. The porous cherts of the Camden formation afford excellent gutta-percha squeezes not only of the larger fossils but also of such microscopic ones, as the Ostracoda. In addition, quite perfect free silicified Ostracoda may be found by washing the white clays resulting from the final decomposition of these cherts. Such specimens reproduce the original ostracod shells with exact fidelity, although they are in reality siliceous pseudomorphs formed as a result of several replacements. First, the original calcareo-chitinous shells are replaced by lime; next by silica, when the enclosing limestone is changed to chert; then the silicified fossils are leached out leaving molds that later are filled by another infiltration of a different form of silica; and finally, the silicified limestone is reduced by weathering to a white clay, a form of tripoli, leaving the fossils, now siliceous pseudomorphs for the second time, unchanged.

More study is necessary upon the various Early Devonian ostracod

[1] Published by permission of the Secretary of the Smithsonian Institution. Received October 10, 1940.
[2] Amer. Journ. Sci. (4) **7**: 429–430. 1899.
[3] U. S. Geol. Surv. Bull. **896**. 1938.
[4] Amer. Journ. Sci. (4) **46**: 732–755. 1918.

faunas, but the present assemblage seems to be related to that from the Lower Oriskany Shriver chert of Maryland and Pennsylvania and the Onondaga of the same States. A small sample of the Clear Creek chert from the vicinity of Jonesboro, Ill., shows good casts of many of the species herein described from west Tennessee, so that there appears to be no doubt of the equivalence of these two formations.

The following descriptions have been much abbreviated not only to save space but also because the author believes that the long discussions of Paleozoic Ostracoda so often printed are more confusing than helpful and that an accurate photographic figure clearly showing the characters combined with a few remarks as to the specific features is sufficient for most purposes. All the specimens illustrated on the plate are from clay beds resulting from the decomposition of chert layers near base of the Camden formation at the quarry half a mile south of Camden, Tenn. Collections at this point were made by Professor Schuchert for the National Museum many years ago, then by the writer later, and finally in more abundance by Dr. G. A. Cooper and R. D. Mesler in recent years. The types are the property of the U. S. National Museum. Measurements are omitted throughout this article because they can be easily determined from the illustrations.

DESCRIPTIONS OF GENERA AND SPECIES

Paraparchites mesleri n. sp. (Leperditellidae Ulrich and Bassler) Fig. 1

Carapace similar to *P. subrotunda* Ulrich from the Onondaga (Jeffersonville) limestone of the Falls of the Ohio, but differing in that the ends of the valves are almost equally rounded. The specimen figured by Kindle in 1912 from the Onondaga of Little Moccasin Gap, W. Va., as *Leperditia subrotunda* Ulrich, has the ends similarly rounded and in spite of its imperfect preservation should probably be referred to this new species.

Halliella pulchra n. sp. (Primitiidae Ulrich and Bassler) Fig. 2

Although related to the genotype *H. retifera* Ulrich from the Onondaga (Jeffersonville) limestone at the Falls of the Ohio, this beautiful new species may be distinguished by its equally ended, more evenly elevated, coarsely reticulated valves, with a thin crestlike border around the free edges and a slightly curved carina above the hinge line. A faint median sulcus terminates in a small, deep, almost central pit.

Parabolbina loculosa n. sp. (Hollinidae Swartz) Fig. 3

Similar to *P. limbatus* Swartz, 1932, from the Oriskany (Shriver) chert of Pennsylvania, but differing in the more prominent well-rounded node on each side of the dorsal median sulcus, in the long narrow anterior spine, and the frill along the posterior half of the ventral margin composed of four folds forming well-marked loculi.

Ctenoloculina n. gen. (Tetradellidae Swartz)

Tetradella-like shells with valves crossed transversely by four flat-topped,

finely reticulated ridges separated by narrow furrows and with the free margins surrounded by a false border, which in the female is swollen to form 4 to 6 loculi or brood chambers. Right valve grooved on free margin to receive edge of the left.

Genotype.—Tetradella cicatricosa Warthin, 1934. Hamilton of Michigan, Ontario, etc.

Ctenoloculina cristata n. sp. Fig. 4

In this new species the four reticulated ridges are not as regularly arranged as in the genotype, the posterior one being crossed by a furrow dividing it into two; the next one being irregularly triangular in outline; and the third and fourth, the two anterior ones, being separated only by a sharp crestlike line. This crest is joined by one bounding the anterior ridge and proceeds posteriorly along the free margin above the true edge of the valve. In the female form three loculi are found in the posterior half between this crest and the true margin.

Bollia ungulata n. sp. (Drepanellidae Swartz) Fig. 5

Like *B. ungula* Jones but differing in the shorter, higher valves with a more pronounced bulb occupying the anterior limb of the inner ridge.

Bollia tribolbina n. sp. Figs. 6, 7

Characterized by its small, elongate carapace with narrow uniformly developed outer ridge closely following the entire free margin, and a sharply angulated inner ridge composed of a bulbous anterior part and narrower ventral and posterior portions, each ending in a slight expansion.

Bollia obesoides n. sp. Figs. 8, 9

Similar to *B. obesa* Ulrich from the Onondaga (Jeffersonville) limestone of the Falls of the Ohio, but differing in the more developed and rounded marginal ridge and the minute spines along both ridges but particularly along the ventral edge.

Bollia burgeneri Swartz, 1932 Fig. 10

This species, which is quite similar to *B. sagittaformis* Swartz, 1932, differs in that the posterior limb of the inner ridge is quite enlarged to form a somewhat rounded, flattened knob. The Tennessee specimens vary from the typical Shriver chert Pennsylvania form in the greater thickness of the posterior limb, a character apparently not of varietal importance.

Bollia sagittaformis Swartz, 1932 Fig. 11

The large size, the well-rounded and uniformly developed outer ridge, the equally obtuse cardinal angles, the U-shaped inner ridge with triangular harpoon-like knob forming the anterior portion, and the narrow posterior limb, characterize this fine species, which is one of the commonest ostracods in this fauna.

Ulrichia crassimuralis n. sp. (Drepanellidae Swartz) Fig. 12

Although much like the genotype *U. conradi* Jones, from the Hamilton at Thedford, Ontario, in outline, minute punctation, and arrangement of the nodes, this species is readily distinguished by its well-developed, more pronounced marginal ridge.

Aechmina longior n. sp. (Aechminidae Swartz) Fig. 13

Very similar to *A. cuspidata* Jones from the Wenlock of England, but the dorsal spine is relatively longer and narrower and the free edges of the valves are furnished with very delicate spicules.

Aechmina equilateralis n. sp. Fig. 14

Although quite similar to several species of this genus, this one is distinguished by the short blunt spine arising from about the middle of the upper edge of the valve which in addition is equal ended and bears minute spines along its ventral edge.

Amphissites ulrichi n. sp. (Kirkbyidae Ulrich and Bassler) Fig. 15

Although obviously related to *A. subquadrata* Ulrich of the Onondaga (Jeffersonville) limestone at the Falls of the Ohio, etc., the marginal free edge in this new species is distinctly raised but the coarse reticulation continues to the border of the valve. Moreover, the dorsal angles are more obtuse and equal, the carapace is larger, and the surface markings are coarser.

Amphissites lunatus n. sp. Fig. 16

This beautiful species is readily recognized by the broad, crescentic, elevated band crossing the carapace parallel but at some distance from the ventral edge, covered with scalelike reticulations. A well-developed central pit occurs just above this band, and the entire surface in general is marked by finely reticulate ornamentation. Rising just above the free margins of the valve is a sharp linear crest.

Thlipsura furcoides n. sp. (Thlipsuridae Jones) Figs. 17, 18

This fine, abundant species differs from *T. furca* Roth of the Helderbergian

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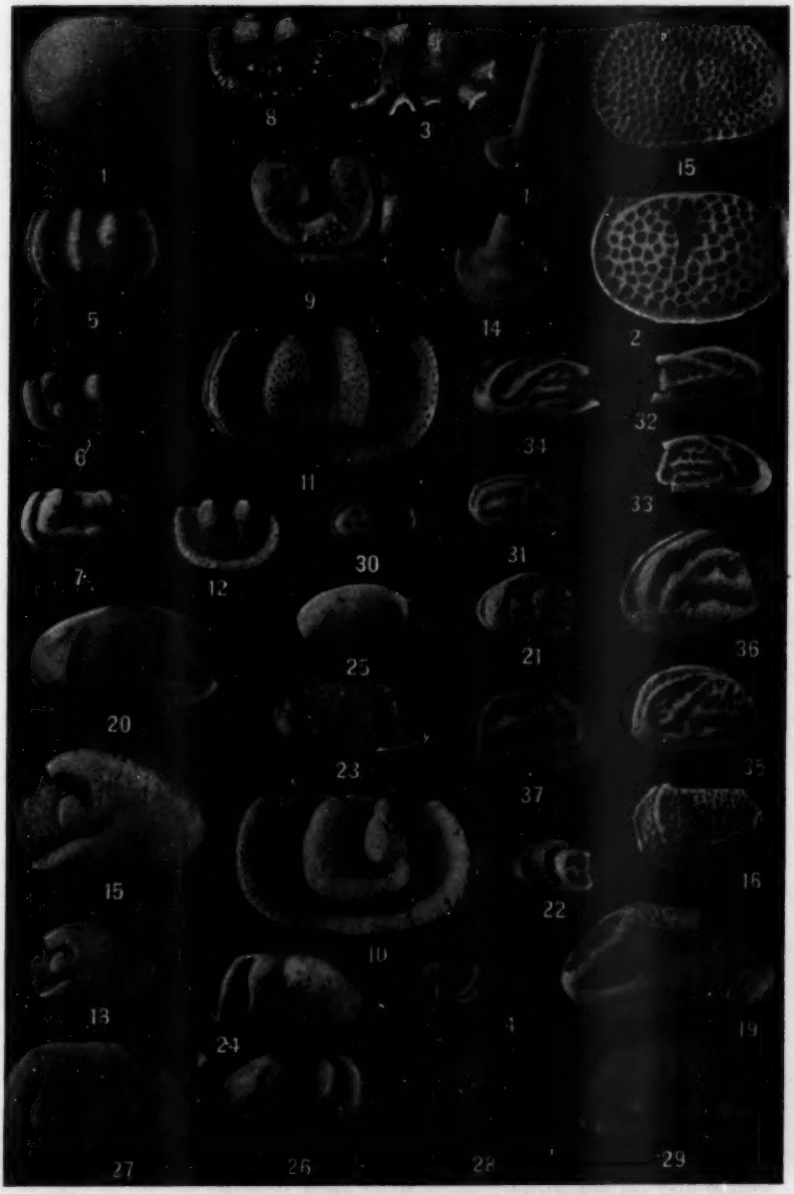
Illustrations ×20 of Camden chert (Onondaga) Ostracoda from Camden, Tenn. The catalog numbers are those of the U. S. National Museum.

Fig. 1.—*Paraparchites mesleri* n. sp. (holotype, right valve probably, No. 101021). Fig. 2.—*Halliella pulchra* n. sp. (holotype, right valve, No. 101022). Fig. 3.—*Parabolbina loculosa* n. sp. (holotype, imperfect left valve, No. 101023). Fig. 4.—*Ctenoloculina cristata* n. gen. and sp. (holotype, male, right valve, No. 101024). Fig. 5.—*Bollia ungulata* n. sp. (holotype, right valve, No. 101025). Figs. 6, 7.—*Bollia tribolbina* n. sp. (cotypes, right and left valves, No. 101026). Figs. 8, 9.—*Bollia obesoides* n. sp. (cotypes, two left valves, No. 101027). Fig. 10.—*Bollia burgeneri* Swartz, 1932 (plesiotype, right valve, No. 101028). Fig. 11.—*Bollia sagittaformis* Swartz, 1932 (plesiotype, left valve, No. 101029). Fig. 12.—*Ulrichia crassimuralis* n. sp. (holotype, right valve, No. 101030). Fig. 13.—*Aechmina longior* n. sp. (holotype, left valve, No. 101031). Fig. 14.—*Aechmina equilateralis* n. sp. (holotype, right valve, No. 101032). Fig. 15.—*Amphissites ulrichi* n. sp. (holotype, right valve, No. 101033). Fig. 16.—*Amphissites lunatus* n. sp. (holotype, right valve, No. 101034). Figs. 17, 18.—*Thlipsura furcoides* n. sp. (cotypes, left valves of a mature and a young specimen, No. 101035). Fig. 19.—*Thlipsurella laevis* n. sp. (holotype, left valve, No. 101036). Fig. 20.—*Thlipsurella cooperi* n. sp. (holotype, right valve, No. 101037). Figs. 21 22. *Thlipsurella secoclefta* Swartz, 1932 (plesiotypes, two right valves, No. 101038). Figs. 23, 24.—*Thlipsurina elongata* n. gen. and sp. (cotypes, right and left valves, No. 101039). Fig. 25.—*Thlipsurina simplex* n. sp. (holotype, right valve, No. 101040). Fig. 26.—*Thlipsurina similis* n. sp. (holotype, right valve, No. 101041). Figs. 27, 28.—*Ranapeltis typicalis* n. gen. and sp. (cotypes, right valves of a mature and a young specimen, No. 101042). Fig. 29.—*Ranapeltis unicarinata* n. sp. (holotype, left valve, No. 101043). Figs. 30, 31.—*Octonariella clavatula* n. sp. (cotypes, left valves, No. 101044). Figs. 32, 33.—*Octonariella bifurcata* n. sp. (cotypes, right valves, No. 101045). Figs. 34, 35.—*Octonariella bispinosa* n. sp. (cotypes, left valves, the latter slightly broken, No. 101046). Figs. 36, 37.—*Octonariella typica* n. gen. and sp. (cotypes, left and right valves, No. 101047).



Figs. 1–37.—(See opposite page for explanation.)

(Haragan marl) of Oklahoma in its more robust elongate carapace, flatter valves, its shorter and more bulbous median ridge, and its sharper, more projecting ventral protuberance.

Thlipsurella laevis n. sp. (Thlipsuridae Jones) Fig. 19

Valves reniform in outline with narrow posterior end. Surface gently rounded with a flat margin along dorsal two-thirds of anterior end bounded by a sharply elevated, narrow, diagonally direct ridge behind which is a broad furrow irregularly triangular in outline extending to the middle of the valve along the midlength. Right and left valves with similar surface markings.

Thlipsurella cooperi n. sp. Fig. 20

Valves elongate oval, with gently rounded surface marked at the posterior end by a slightly curved sulcus and at the anterior end by a flattened margin along the dorsal two-thirds bounded by a curved ridge, which in turn is succeeded by a narrow, somewhat triangular furrow.

Thlipsurella secoclefta Swartz, 1932 Figs. 21, 22

The Tennessee specimens here figured agree with the Pennsylvania Shriver chert types in all respects except that the submedian cleft is better developed and the two pits behind it are often united.

Thlipsurina n. gen. (Thlipsuridae Jones)

Similar to *Thlipsura* in general shell characters but differing in the absence of a posterior sulcus and in the presence of a broad, shallow, transverse, median depression and of a flattened anterior end bounded by a sharp ridge which in turn is followed typically by a broad, deep, curved sulcus expanding in width from the hinge line to the ventral margin. Surface markings alike on both valves.

Genotype.—T. elongata new species.

Thlipsurina elongata n. sp. Figs. 23, 24

The elongate carapace, the flattened anterior marginal area succeeded posteriorly by a well-developed sulcus increasing in width toward the ventral edge, and the broad median transverse shallow depression, characterize this new species.

Thlipsurina simplex n. sp. Fig. 25

Similar to *T.* (*Thlipsura*) *primitiva* (Roth) from the Helderbergian (Haragan) of Oklahoma, but differing in the oval instead of wedge shape of the valves and the narrow, flattened anterior border.

Thlipsurina similis n. sp. Fig. 26

Similar to the genotype but differing in the less elongate, higher carapace with the central depression better developed. Both sides of the carapace are known and are similar to each other.

Ranapeltis n. gen. (Thlipsuridae Jones)

Hinge, without overlap, but right valve seems slightly to overlap left along the ventral margin. Valves subtrapezoidal to subreniform marked in the type species by two narrow ridges developed parallel to the ventral margin and turning upward at an acute angle towards the dorsal edge and in the second species by only a single ridge. A large eye spot or muscle scar is centrally located within the inner ridge and the free edge of valves bears a spine at the angular anterior end.

Genotype.—R. typicalis new species.

Ranapeltis typicalis n. sp. Figs. 27, 28

The two parallel ridges bent abruptly toward the dorsal but reaching only about half the distance, the muscle spot, and the angular anterior ventral margin with its pointed spine, are characters that make this ostracod easy to identify.

Ranapeltis unicarinata n. sp. Fig. 29

Although similar in general features to the genotype, this species has but a single ventral ridge, which, however, in turning toward the dorsal margin bends abruptly toward the center, each end terminating in a decided bulb, with the strongly marked muscle impression midway between them. The anteroventral spine is as well marked as in the type species.

Octonariella n. gen. (Thlipsuridae Jones)

Inequivalved shells with the larger left valve overlapping the right on the free edges, the surface pattern of opposite valves sometimes different and the typical U-shaped annular ridge of *Octonaria* replaced by a single ridge in the anterior half and a bifurcated ridge posteriorly, the latter terminating in two prominent spines one at each end of a sharp transverse connecting bar. Spaces between ridges marked by a series of pitlike depressions.

Genotype.—O. typica new species.

Octonariella clavatula n. sp. Figs. 30, 31

Anterior and posterior ridges so joined that valve appears traversed lengthwise by three parallel elevations, the outer two united at the anterior end and terminating in a bar with spines at the posterior. Two rows of pits developed between the three elevated areas. Although related to *O. (Octonaria) clavigera* (Ulrich) of the Onondaga at the Falls of the Ohio, the central ridge in the present species does not stand out like a club.

Octonariella bifurcata n. sp. Figs. 32, 33

This well-marked ostracod may be recognized by its narrow elongate form and very prominent posterior spines. In the distribution of the ridges and depressions it resembles *O. bispinosa* a broader species of which it might be considered the opposite valve. This is not the case, however, since both right and left valves with the characters here figured are known.

Octonariella bispinosa n. sp. Figs. 34, 35

Both valves of this common species are known and differ little from each other. The characteristic features are the shorter, higher form of the valve and the consequent increase in the number of depressions between the ridges, which as usual end in two well-marked spines.

Octonariella typica n. sp. Figs. 36, 37

This very abundant ostracod is represented by both valves and complete examples leaving no doubt that the two somewhat different aspects figured represent the same species. The smaller (right valve lacking the broad overlapping border of the left bears a row of large coarse pits next to the anterior free margin and two rows of two and of three pits, respectively, parallel to the ventral margin. The latter rows are joined by a crest at each end of which is a small sharp spine. The larger overlapping valve has the same general arrangement of pits but broad posterior and anterior borders distinguish it.

PALEOBOTANY.—*Notes on the Pleistocene of Maryland.*[1] EDWARD W. BERRY, Johns Hopkins University.

The idea that the Pleistocene deposits south of the terminal moraine were due to changes in relative level of land and water and were to be interpreted by their topographic height and form we owe to Shattuck, who, after setting forth his hypothesis in several earlier papers, gave it its final form in 1906 in the volume discussing the Pliocene and Pleistocene deposits of Maryland. Shattuck was a brilliant worker, but not a sustained and persevering detailist. Having published his interpretation he apparently lost interest in it and never during the rest of his life returned to the subject. It was, however, adopted by a number of younger men and extended throughout the remainder of the Atlantic and Gulf Coastal Plain. There have always been physiographers who have been violently critical, although on the whole I think it is fair to say that Shattuck's interpretation, with, of course, modifications of detail, has been generally accepted by geologists. One of the difficulties for many minds has been the problem of visualizing a complex series of events in terms of a rather rigid scheme of changes of level, or of differentiating the episodes in an actual exposure from the final event that controlled the surviving topographic form. There was, too, the difficulty in many minds of visualizing the marine control, which changes of level exercised in stream valleys even though the sediments were not actually marine and did not contain marine fossils. The time involved is inconsiderable as geologic time is reckoned and such fossils as have been found, either animal or plant, have in consequence had but slight if any stratigraphic value, and reflect shifting environments and changing geographical distribution among groups of organisms whose specificity was, for the most part, unchanged throughout the whole interval from early Pleistocene to modern times.

It is not my purpose to attempt a history of opinion of the Coastal Plain terrace formations or to discuss them formally within even the limits of Maryland, and the foregoing remarks are made as introductory to a consideration of certain local observations.

Dr. C. W. Cooke, who has written considerable on the Coastal Plain terrace formations, advocates a revised terminology for the younger ones[2] and proposes that the name Talbot terrace, which derives from Talbot County on the Eastern Shore, be retained for the

[1] Received October 4, 1940.

[2] COOKE, C. W. Journ. Washington Acad. Sci. 21: 503–513. 1931.

42-foot level and that for a younger Talbot stage observed in some places in Maryland the name Pamlico be extended from North Carolina, where this stage is beautifully developed. The Pamlico has an altitude of about 25 feet and has been recognized in Prince Georges County and the District of Columbia at both of which it has furnished a considerable flora.[3] C. K. Wentworth[4] recognized a still lower level in Virginia for which he proposed the name Princess Anne, which has an altitude of about 12 feet. Cooke dissents from this proposal of Wentworth's. If accepted, both the Airport deposits and those at Wagners Point, which are discussed in the following pages, would be referred to the Princess Anne stage of the late Pleistocene, although it is possible, but not demonstrable, that traces of older Pleistocene deposits are shown in the test borings at the Airport.

MUNICIPAL AIRPORT

Through the cooperation and intelligent interest of W. Watters Pagon, consulting engineer on the Baltimore Airport, I am indebted for samples and for the records of a series of test borings. The former have furnished a few identifiable plants from the deposits and the latter some interesting data on changing conditions and less clear indications of past changes of level. They show, for one thing, considerable erosion in the Cretaceous surface previous to the deposition of the Pleistocene. At the Airport the Cretaceous is encountered about 60 feet below tide, whereas on the opposite shore of the Patapsco and a couple of miles down the dip near Hawkins Point the Cretaceous rises to a height of 24 to 28 feet above tide.

The borings show also considerable thicknesses of carbonaceous clays with plant remains, possibly marsh deposits, separated by two or three intervals of coarser water laid and presumably stream deposits. These might be interpreted as due to alternating times of elevation and depression and as referable to different-named stages in the Pleistocene, but since exact lithological correlations are impossible between adjacent borings I am inclined to think that the major factor is shifting conditions—what might be called "scour and fill"—rather than changes in level, although minor changes must inevitably have occurred.

The plants found in the clays (mud) include (1) badly decayed dicotyledonous wood, otherise unidentifiable; (2) leaf fragments and an

[3] BROWN, R. W. op. cit. and BERRY, E. W. Journ. Washington Acad. Sci. **23**: 1–25. 1933.

[4] WENTWORTH, C. K. Virginia Geol. Survey Bull. **32**. 1930.

acorn cupule of *Quercus* sp.; (3) a seed and numerous leaf fragments of *Fagus americana.*

WAGNERS POINT

On the south bank of the Patapsco between Wagners and Fishing Points, directly across from the Airport, the land surface is only a few feet above tide. Excavations for a WPA sewer project have thrown out a large amount of material. Its lithologic similarity to that encountered in the borings at the Airport led to its careful examination, although no information was obtainable as to its stratigraphic relations. Considerably more identifiable plants were found in these deposits. The material is a very silty uncompacted dark grayish, often very micaceous clay, with scattered quartz pebbles, full of leaf fragments mostly very much broken and thoroughly macerated. Obviously stream lain and apparently in a backwash or eddy on a tidal flat. An occasional seed, small broken sticks and fragments of bark, pieces of acorns or cupules, husks and nuts of a hickory, etc.

I have seen innumerable cove beaches in the estuaries around Chesapeake Bay where the material is of the same silty texture and where at low tide one observes fragments of oak or similar coriaceous leaves, occasional sticks or hard fruits and pine cones that seem to me to duplicate the conditions during the Pleistocene in this general region. This is especially true of the sediments as well as the plant contents in the material from Wagners Point.

The plant material consists of the following:

Pinus virginiana (Mill.) A single small cone-scale. This is still a common species hereabouts and according to Chrysler forms both pure stands and mixed pine-oak associations in southern Maryland. In its wider range it extends from Long Island, N.Y., to South Carolina in the Coastal Plain. It has not previously been found fossil.

Taxodium distichum (L.) L. C. Rich. The bald cypress is found in the Coastal Plain Pleistocene at innumerable localities from New Jersey to Florida and Louisiana. These are usually of Talbot or Pamlico age, but some very large stumps were encountered in excavating for the Mayflower Hotel in Washington,[5] which are referred to the Wicomico formation. It is present in the clays at Wagners Point by detached leaves, which are very characteristic when first collected. At the present time the bald cypress reaches its northern limit in southern Charles County, but during the Pleistocene it ranged northward as far as New Jersey and in this latitude it ranged inland to the Fall Line, or even beyond.

Hicoria ovata (Mill.) Britton. A single nut and many nearly complete sections of the very thick husks. In general this is now a rich soil species ranging from Canada to western Florida, Alabama, and Mississippi. Accord-

[5] BERRY, E. W. Journ. Washington Acad. Sci. 14: 15, pl. 1, figs. 37–42, pl. 3. 1924.

ing to Chrysler it is frequent in what he calls Oak-Hickory association in southern Maryland. *Hicoria ovata* has a large number of Pleistocene records including Pennsylvania, Maryland, District of Columbia, and North Carolina. It occurs in deposits correlated with the Pamlico formation both in the District of Columbia and Prince Georges County, Md.

Alnus rugosa (Du Roi) K. Koch. A leaf. The alder is common on wet soil in Maryland, ranging northward to Maine and southward to Florida and Texas. *Alnus rugosa* has been recorded from the Talbot of Drum Point, Md., and the Pamlico of the District of Columbia.

Fagus americana Sweet. Many leaf fragments and an immature fruit. The beech is widespread in the Coastal Plain Pleistocene from Pennsylvania to Texas. Its modern range is from Ontario to Florida, and it is not uncommon in tidewater Maryland.

Quercus sp. Small fragments of bristle-tipped lobes of oak leaves are rather common. They are too incomplete for specific determination but represent *rubra, velutina,* or *digitata.* The first of these has been recorded from the Pamlico of Prince Georges County.

Vitis cf. *cordifolia* Michaux. A single characteristic seed, probably of this species. Grape seeds are common in the Coastal Plain Pleistocene from New Jersey to Louisiana and are widespread in the Talbot of Maryland.

OSTREA VIRGINICA IN THE COLGATE DISTRICT OF EAST BALTIMORE

An interesting specimen is a large fragment of "coquina" made up of fragments of the common *Ostrea virginica* collected at the borrow pit from which the City of Baltimore is taking fill for the Municipal Airport. The specimen was turned over to the consulting engineer by a workman, and the approximate depth was 8 or 9 feet below the surface at the base of the gravels, which are supposed to be of Sunderland age and close to the contact with the underlying Upper Cretaceous. The altitude is about 100 feet. The location is at the corner of the proposed extensions of Boston Street and the Broening Highway.

There are a number of considerations that can not now be verified before the authenticity of the find can be accepted. If we assume that it was collected in place, the oyster bed should be more extensive. Oyster spat would hardly set and grow to maturity in a rapidly forming gravel deposit. It might be concluded that the pieces were torn from a contemporaneous oyster bed and deposited with the gravel. The depth at which the specimen was found precludes its having come from a refuse dump of some oyster cannery or old shell road or Indian kitchen midden. The last would hardly be likely to occur at a distance from the present shores; an old road fragment would hardly be so cleanly washed.

If the specimens are actually indigenous in the Sunderland it is the first record of marine or estuarine fossils in any of the Maryland terrace formations older than the Talbot. *Ostrea virginica* occurs abun-

dantly in the Talbot of Calvert, St. Marys, Talbot, and Caroline Counties, Maryland. The present record is much more remote from modern marine waters and, if authentic, goes a long way toward substantiating the accepted theory of the marine origin of the Pleistocene terrace deposits.

WHITE OAK FROM BED OF CARDIFF AVENUE

I am indebted to W. W. Pagon for a specimen of a small stump of some species of the white-oak section of *Quercus* collected from the bed of Cardiff Avenue, 250 feet east of the Broening Highway. This was found 12 feet below the present surface and may be of Wicomico age. The specimen is of the extreme base of a stump and is about 8½ inches high, worn to a pointed top and rotted to a hollow on the under side.

Anatomical features afford no satisfactory basis for differentiating species among the white oaks. Of the recent species of white oaks in the Coastal Plain of this latitude *Quercus alba* occurs abundantly in the Pleistocene from the Interglacial of Canada (Don River) to North Carolina and Tennessee. In Maryland it is found in the Sunderland of Calvert County and the Pamlico of Prince Georges County; *Quercus lyrata* occurs in the Pleistocene of North Carolina, Louisiana, and Texas.

HEMLOCK FROM BRIGHTSEAT, PRINCE GEORGES COUNTY

Perfectly characteristic cones of *Tsuga canadensis* (L.) Carriere were collected by Dr. Charles T. Berry from the Pleistocene overlying the Monmouth Upper Cretaceous at the well-known Monmouth fossiliferous exposure near Brightseat, Prince Georges County.

Previous fossil records of hemlock are from peat deposits in southeastern Canada[6] and from Pamlico deposits along Northwest Branch Anacostia River in Prince Georges County, Md., where both wood and cones have been found.[7]

In the modern flora this tree is found from Nova Scotia to eastern Minnesota, southward to northern Delaware and along the Appalachians to northwestern Alabama (Sargent). In Maryland it is known naturally from but a single locality in the Coastal Plain (Watts Creek, Caroline County) (Chrysler), a doubtful record; it is sparing in the Lower Midland Zone (Shreve), frequent in the Upper Midland Zone (Blodgett), and abundant in the Mountain Zone (Shreve).

[6] AUER, V. Geol. Surv. Canada Mem. 162: 32. 1930.
[7] BROWN, R. W. Journ. Washington Acad. Sci. 25: 443. 1935.

ZOOLOGY.—Contracaecum quincuspis, *a new species of nematode from the American waterturkey.*[1] JOHN T. LUCKER, U. S. Bureau of Animal Industry. (Communicated by E. W. PRICE.)

A female *Contracaecum* with lips and interlabia of remarkably complex structure was observed among some nematodes from the waterturkey (*Anhinga anhinga*) deposited in the U. S. National Museum Helminthological Collection. The only known species in which these structures vary conspicuously from the pattern usual in the genus is *C. tricuspis*[2] (Gedoelst, 1916) Baylis, 1920; but it was immediately apparent that the lips and interlabia of the specimen from the waterturkey differed from those described and figured for that species by Gedoelst (1916). Some specimens labeled "*Contracaecum tricuspe*" from *Anhinga anhinga* were available for comparison; but the lips and interlabia of these specimens and of the one originally examined by the writer were identical morphologically.

Other less striking discrepancies were also noted between the American specimens and *C. tricuspis*, which was originally described as *Kathleena tricuspis*, from a "Héron" from Belgian Congo. The species has subsequently been recorded by Baylis and Daubney (1922) from *Anhinga melanogaster* from India and by Baylis (1933) from the same host from Java.

It seems odd that two species of *Contracaecum* having elaborate lips and interlabia as their principal feature of difference from the pattern typified by such species as *C. microcephalum* and *C. punctatum* should occur in closely related hosts, even though the latter are from regions widely separated geographically. Nevertheless, the American specimens must be regarded as distinct from *C. tricuspis* on the basis of the present characterization of that species. Certainly there is no existing objective evidence, and no reason to assume or believe, that Gedoelst overlooked obvious and readily observed morphological features of the lips and interlabia of his species. From the nature of Baylis and Daubney's (1922) paper, which included descriptions of new species and redescriptions of previously known species of Anisakinae, it seems likely that these authors would have called attention to important discrepancies between Gedoelst's description and the Indian specimens identified by them, had any existed. Hence, the specimens from the American waterturkey are here described as a new species.

[1] Received September 24, 1940.

[2] Baylis (1920) emended the spelling of the specific name to "*tricuspe*," but as the reason for this is not clear, the original spelling is used in this paper.

Contracaecum quincuspis n. sp. Figs.1–7

Description.—Lacking a distinct collar between anterior limit of cervical region and head, but with definite encircling groove marking junction of these regions (Fig. 1); posterior superficial margins of lips and interlabia discrete from anterior limit of cervical region. Cuticle of cervical region immediately behind lips not presenting "shirred" appearance. Lips and interlabia of complicated structure as follows: Each lip, viewed from without, with lateral margins deeply incised a short distance anterior to base, the notches or furrows extending nearly to median line of lip (Fig. 1). Outline of basal portion of lip, posterior to furrows, resembling a pair of wings connected to main body of lip by median construction or neck produced by incisions. Main body of lip, bearing papillae of external circle, appearing more or less elliptical in outline; posterior and posterolateral margins formed by basal furrows; lateral extremities convexly rounded, anterolateral margins converging toward median line, but not meeting. Internal and anterolateral to anterior curvatures of main body of lip, winglike processes, more or less acutely pointed at their lateral extremities, visible in this view (Fig. 1). *En face* view (Figs. 3, 4) shows that these processes represent lateral extremities of internal, more or less heart-shaped apex of lip; an anterior pair of incisions, passing from lateral extremities of lip toward median line and somewhat posteriorly, at first, then curving internally toward mouth axis and terminating some distance from tip of lip, separate heart-shaped apex from main body of lip, with only a narrow neck connecting the two. Apical process considerably narrower than main body of lip, its straight anterolateral margins meeting at tip to form obtuse angle; its posterior portion, bounded by anterior pair of furrows, in form of an auricle-like lobe on each side of connecting neck. Base of interlabium, viewed from without, comparatively narrow, discreet from base of neighboring lips (Fig. 2). Interlabium with a pair of slender, laterally directed processes originating just above base, each cusp fitting into complementary basal incision of neighboring lip. Superficial margins of interlabium anterior to basal pair of cusps, narrow, elongate, stemlike, passing between lateral margins of main body of neighboring lips. Stem broadening internally, with internal portion lying below lateral extremities of neighboring lips, and branching distally to form three cusps, an anterolaterally directed pair and a single short internally directed terminal cusp. Distal lateral cusps shorter than basal pair, fitting into complementary anterior incisions between main body and apex of neighboring lips. Terminal median process rounded at tip, usually not detectable from without or in *en face* view, but readily seen if head is dissected (Fig. 3). Cuticular expansions passing from terminal cusp to distal lateral pair and from latter internally along stem. Muscular esophagus long and very slender; ventriculus small, more or less rounded, or slightly elongate,

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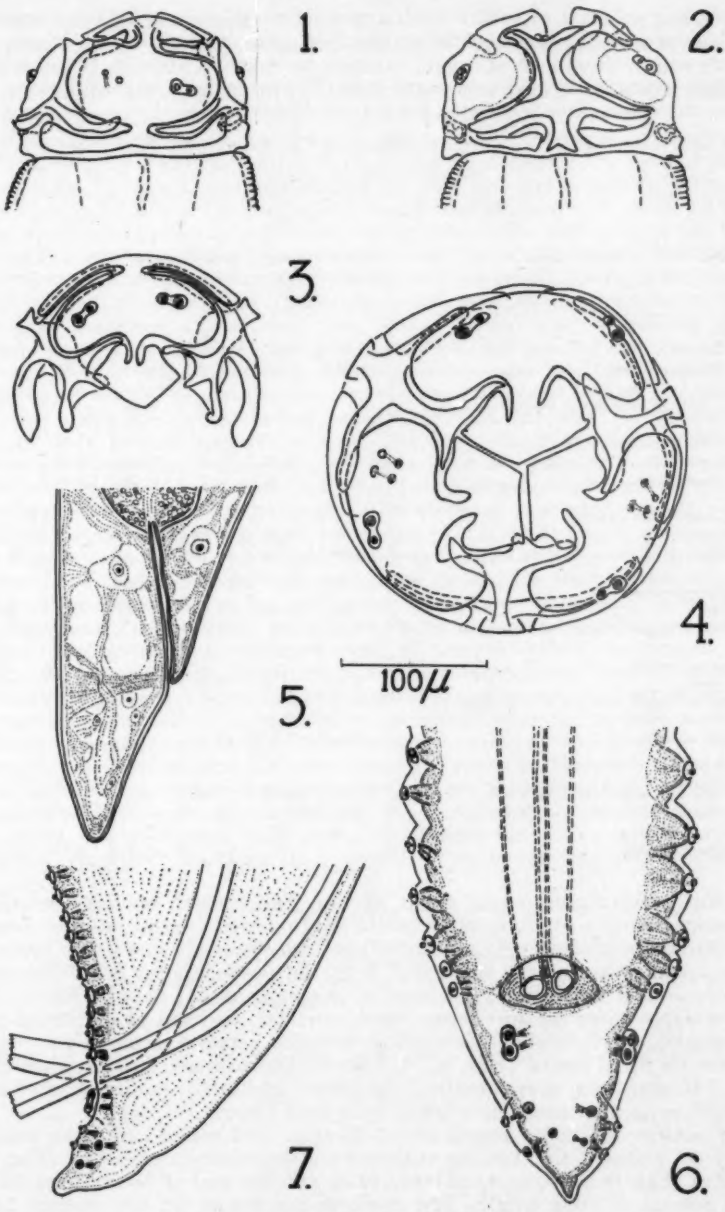
Figs. 1–7.—*Contracaecum quincuspis* n. sp.: 1, Subventral view of head (female) tilted slightly upward; 2, ventral view of head (female) showing interlabium and its relationships with adjacent subventral lips; 3, *en face* view of dorsal lip and subdorsal interlabia from a dissection of head (female); 4, *en face* view of head (female), slightly oblique aspect; 5, lateral view of posterior extremity of female; 6, ventral view of posterior extremity of male tilted slightly toward the right, showing postanal caudal papillae and a few papillae of the preanal series (the protruding portions of the spicules had been cut off); 7, lateral view of posterior extremity of male, showing postanal papillae and a few papillae of the preanal series on the left side. (Figs. 5 and 7 are drawn to one-half the indicated scale.)



Figs. 1–7.—(See opposite page for explanation.)

depending on state of contraction; appendix about one-sixth to one-fourth as long as esophagus; intestinal cecum long, extending almost to region of nerve ring, voluminous at origin, tapering to rounded anterior tip. Deirids slightly posterior to region of nerve ring. The principal size relationships of three male and three female specimens are shown in table 1.

TABLE 1.—PRINCIPLE SIZE RELATIONSHIPS OF CONTRACAECUM QUINCUSPIS n. sp.

(All measurements in millimeters)

Measurement	Female			Male		
	Specimen 1	Specimen 2	Specimen 3	Specimen 1	Specimen 2	Specimen 3
Body:						
Length	23.0	23.0	15.0	12.1	12.5	10.0
Maximum width	0.87	0.97	0.48	0.50	0.43	0.50
Distance from anterior end to nerve ring	—	—	0.29	0.38	—	0.28
Muscular esophagus:						
Length	5.34	6.43	4.27	4.06	3.82	3.98
Average width	0.16	0.15	—	0.08	0.08	0.08
Esophageal ventriculus:						
Length	0.18	0.19	0.15	0.10	—	0.13
Width	0.20	0.25	0.18	0.15	—	0.13
Esophageal appendix:						
Length	0.86	1.18	1.05	0.95	1.27	0.64
Ratio of length to length of esophagus	1:6.4	1:5.5	1:4.2	1:4.4	1:3.1	1:6.4
Intestinal cecum:						
Length	5.10	6.07	3.97	3.34	3.47	2.97
Ratio of length to length of esophagus	1:1.1	1:1.1	1:1.1	1:1.2	1:1.1	1:1.4
Length of tail	0.28	0.33	0.26	0.38	—	0.28
Vulva:						
Distance from anterior extremity	8.15	10.27	7.43	—	—	—
Ratio of distance to body length	1:2.8	1:2.2	1:2	—	—	—
Length of spicules	—	—	—	2.83	2.03	2.24

Male.—Maximum length about 14 mm. Tail conical, curving ventrally, terminating in a small, more or less bluntly pointed ventral process. About 40 pairs of sublateral preanal caudal papillae, consisting of a single more or less linear series in each sublateral field, the posteriormost papilla of each series adanal in position; six pairs of postanal caudal papillae consisting, of a subterminal group of two lateral and two subventral pairs and two prominent subventral double papillae in region between terminal group and posterior lip of cloaca (Figs. 6, 7). Spicules approximately equal, about 3.7 to 4.25 mm. long in apparently fully grown specimens; minimum observed length in smaller specimens slightly more than 2.0 mm.

Female.—Maximum length about 23 mm. Tail conical, tapering gradually to rounded tip, lacking cuticular or hypodermal processes (Fig. 5). Vulva slightly prominent, distance from anterior end of body about 35 to 49 percent of body length. The available specimens did not contain fully developed eggs.

Host.—Anhinga anhinga.

Distribution.—Florida, Arkansas, District of Columbia (National Zoological Park).

Specimens.—U. S. Nat. Mus. Helm. Coll. no. 44559 (holotype; male), 44560 (allotype), 30591 (paratypes), 30592 (paratypes).

Remarks.—Contracaecum quincuspis differs from *C. tricuspis*, as described and figured by Gedoelst (1916), in the following respects: The lateral margins of the lips are deeply incised near the base and also anteriorly between the main body of the lip and the internal apical process; in *C. tricuspis* the lips are notched anteriorly between the apex and the remainder of the lip, only. In *C. quincuspis* the superficial basal margins of the lips and interlabia are discrete; the basal margins of the lips and interlabia are figured as continuous in *C. tricuspis*. In *C. quincuspis*, each interlabium gives rise to five cusps or branches, a prominent long slender lateral pair, originating near the base, a shorter anterolateral pair, and a terminal internal one; the interlabium of *C. tricuspis* bears only the three distal cusps. In *C. quincuspis* two double subventral caudal papillae occur a short distance behind the cloaca of the male; the corresponding papillae are not described as double in *C. tricuspis*. In both species the preanal series of caudal papillae terminate posteriorly laterally to the cloaca so that one or two pairs of these papillae are actually adanal in position. In *C. tricuspis*, however, a subventral papilla, median to the preanals and not aligned with them, is present close to each side of the cloacal opening; such an adanal pair is lacking in *C. quincuspis*. In some specimens of *C. quincuspis* the preanal series were observed to curve toward the median line as they neared the cloaca, the most posterior pair of papillae being more or less subventral in position, although clearly part of the preanal series. In *C. quincuspis* about 40 pairs of papillae comprise the preanal series; in *C. tricuspis* about 56 pairs are said to be present. In cases of convergence in all other important characteristics, these differences in the arrangement of the adanal and postanal papillae and in the number of preanal papillae would be regarded as normal intraspecific variations or as merely representing differing interpretations. But, in this instance they deserve emphasis because they are correlated with the presence of lips and interlabia which, so far as can be judged, are of characteristically divergent structure. Finally, in *C. quincuspis*, the esophageal appendix is about one-sixth to one-third as long as the esophagus; Gedoelst's measurements indicate that in *C. tricuspis* the appendix is about one-half as long as the esophagus.

LITERATURE CITED

BAYLIS, H. A. *On the classification of the Ascaridae. 1. The systematic value of certain characters of the alimentary canal.* Parasitol. 12(3): 253–264. 1920.

———.*On some parasitic worms from Java, with remarks on the acanthocephalan genus* Pallisentis. Ann. Mag. Nat. Hist., ser. 10, 11: 615–633. 1933.

BAYLIS, H. A. and DAUBNEY, R. *Report on the parasitic nematodes in the collection of the Zoological Survey of India.* Mem. Indian Mus. 7(4): 263–347. 1922.

GEDOELST, L. *Notes sur la faune parasitaire du Congo Belge.* Rev. Zool. Africaine 5(1): 1–90. 1916.

ENTOMOLOGY.—*Butterflies of Farmville, Virginia.* AUSTIN H. CLARK, U. S. National Museum, and FRANK W. TRAINER, University of Virginia.[1]

Farmville, the county seat of Prince Edward County, is in south-central Virginia, approximately in the middle of the Upper Austral or Carolinian Zone between the Lower Austral Zone to the east and the Transition or Alleghanian Zone, which includes the mountainous regions in the western part of the State. The country about Farmville has been under intensive cultivation, and all the original forest cover has long since disappeared. Patches of second-growth woodland and a few boggy areas may be found.

There are no published records of butterflies for the region in which Farmville is situated with the sole exception of a notice of the occurrence of *Neonympha areolatus septentrionalis* at Lunenburg.[2] The present paper is based upon intensive studies made by the junior author in the spring and summer of 1940, supplemented by collections made in 1937, 1938, and 1939, when a few species were taken that were not found in 1940. The senior author has in different years collected and taken notes in 3 localities in Prince Edward County and at 26 localities in the surrounding counties—Charlotte, 2; Appomattox, 2; Buckingham, 7; Cumberland, 4; Amelia, 3; Nottoway, 4; and Lunenburg, 4—and these notes have served as a background for the interpretation of the Farmville fauna.

The number of species recorded from Farmville in the following list is 73, to which are added three from nearby regions that are quite likely to be found at Farmville. The total number of species is about half the number known from Virginia. But many species in Virginia are confined to the Transition Zone or Canadian Zone in the western mountains, or to the Lower Austral Zone on the Coastal Plain. It is possible that several species have been extirpated by the intensive cultivation of the land. Future collecting will undoubtedly add a number of species, some of highly localized occurrence, but most more or less casual visitors, especially from the south.

In the following list only the earliest and latest dates are given unless there is a significant gap in the records, or unless records are few. When no year is mentioned 1940 is understood.

Family NYMPHALIDAE: Subfamily SATYRINAE: *Neonympha gemma* (Hübner), IV.25 to V.8; VII.5; VIII.4 to IX.8. *Neonympha areolatus sep-*

[1] Published with the permission of the Secretary of the Smithsonian Institution. Received October 3, 1940.

[2] Jour. Washington Acad. Sci. 27: 212. 1937.

tentrionalis (Davis), not found at Farmville but taken by the senior author at Lunenburg, IX.2.1936 and IV.23.1939, and at Nottoway Falls, IV.23.1939. *Neonympha eurytus* (Fabricius), V.26 to VII.30. *Neonympha sosybius* (Fabricius), V.12 to VI.16; VII.14 to IX.8. *Minois pegala alope* (Fabricius), VII.3 to IX.9; also VI.20.1937 and IX.19.1939. *Satyrodes eurydice* (Linné), VII.4 to IX.1.

Subfamily NYMPHALINAE: *Polygonia interrogationis* (Fabricius), III.16 to V.14; VII.14 to IX.8; one of the dark form V.14. *Polygonia comma* (Harris). III.17 to V.7. *Nymphalis antiopa creta* (Verity), IV.1 to V.26; also III.26 and X.10.1939. *Vanessa atalanta* (Linné), V.11 to VI.3; VI.28 to IX.8. *Vanessa virginiensis* (Drury), IV.11 to V.26; VI.19 to IX.8. *Vanessa cardui* (Linné), VII.10 to 23; VIII.20 to IX.17; not found in 1937, 1938, or 1939. It was not found anywhere in Virginia by the senior author in these three years. *Precis coenia* (Hübner), VI.1 to IX.8. *Basilarchia arthemis astyanax* (Fabricius), V.22 to IX.9. *Basilarchia archippus* (Cramer), VII.6 to IX.1; not common. *Phyciodes nycteis* (Doubleday and Hewitson), not found at Farmville but taken by the senior author at Lunenburg, IX.2.1936. *Phyciodes tharos* (Drury), V.2 to IX.10. *Argynnis cybele* (Fabricius), V.31 to VIII.31; in 1937, V.28. *Euptoieta claudia* (Cramer), VII.26; IX.1, 7.

Subfamily DANAIINAE: *Danaus plexippus* (Linné), V.27 to IX.10; more common in early and midsummer than usual.

Subfamily LIBYTHEINAE: *Libythea bachmani* (Kirtland), VIII.3, 23; IX.14.

Family LYCAENIDAE: Subfamily SPALGINAE: *Feniseca tarquinius* (Fabricius), IV.17; VII.4, 5.

Subfamily LYCAENINAE: *Lycaena phlaeas hypophlaeas* (Boisduval), IV.25 to VII.7; in 1937, IV.8. *Lycaenopsis argiolus pseudargiolus* (Boisduval and LeConte), III.31 to VII.14; also VIII. 12,1939. *Everes comyntas* (Godart), IV.7 to IX.9.

Subfamily THECLINAE: *Eupsyche m-album* (Boisduval and LeConte) IV.17, two on redbud; IV.29, one on apple blossom. *Strymon titus mopsus* (Hübner), VI.14 to VII.14. *Strymon liparops* (Boisduval and LeConte), VI.30. *Strymon falacer* (Godart), VI.9 to VII.22. *Strymon melinus* (Hübner), IV.25 to IX.8. *Calycopis cecrops* (Fabricius), V.5 to IX.8; also IV.30. 1939. *Mitoura gryneus* (Hübner), V.5 to VIII.11. *Incisalia niphon* (Hübner), VI.30 (only one seen); in 1937, in April.

Family PAPILIONIDAE: Subfamily PIERINAE: *Pieris rapae* (Linné), III.28 to IX.10. *Pieris protodice* Boisduval and LeConte, III.29 to VIII.17. *Anthocharis genutia* (Fabricius), IV.4 to 5.V. *Phoebis eubule* (Linné), IV.24. 1939; IX.19.1937; not seen in 1940. The senior author found it at Farmville, IV.24.1939, at Goochland Court House on the same date, and at Blackstone, Nottoway County, IV.23.1939. It is unusual to find this butterfly in Virginia in spring. *Colias philodice philodice* Godart, IV.16 to V.16; IX.8, 9; also III.27.1939. *Colias philodice eurytheme* Boisduval, form *ariadne*, IV.3 to V.26; form *eurytheme*, V.5 to IX.9; in 1939 to XI.29. *Eurema nicippe* (Cramer), IV.16; IX.1. *Eurema lisa* (Boiduval and LeConte), VII.19 to IX.10; also X-30.1938.

Subfamily PAPILIONINAE: *Papilio philenor* Linné, IV.17 to IX.7. *Papilio polyxenes asterius* Cramer, IV.10 to IX.10. *Papilio cresphontes* Cramer, IX.4 (seen). *Papilio glaucus* Linné, IV.4 to IX.7; in 1939, III.26. *Papilio troilus* Linné, IV.10 to IX.10. *Papilio marcellus* Cramer, IV.10 to VIII.24; seldom more than a few seen each season; more frequent than usual in 1940.

Family HESPERIIDAE: Subfamily PYRGINAE: *Epargyreus clarus* (Cramer), IV.29 to IX.10; in 1939, IV.26. *Achalarus lyciades* (Geyer), V.26 to

VIII.26. *Rhabdoides cellus* (Boisduval and LeConte), VIII.11. *Thorybes bathyllus* (Smith), V.5 to IX.10; in 1939, IV.30. *Thorybes pylades* (Scudder), V.25 to VIII.6. *Thorybes confusis* Bell, VI.6 to VIII.8. *Pyrgus communis* (Grote), V.16 to IX.9; in 1937, V.9. *Pholisora catullus* (Fabricius), V.7 to IX.1. *Erynnis icelus* (Scudder and Burgess), not found at Farmville; the authors took it at Morven, Amelia County, IV.28.1940. *Erynnis brizo* (Boisduval and LeConte), IV.29; V.5, 13; also III.27.1938. *Erynnis martialis* (Scudder), V.19; VII.7, 21 26; VIII.9, 18; also V.16 and VII.10.1937. *Erynnis juvenalis* (Fabricius), IV.7 to V.5; also III.27.1938. *Erynnis horatius* (Scudder and Burgess), V.5. *Erynnis zarucco* (Lucas), V.19; VII.7. This butterfly has not heretofore been found in spring in Virginia.

Subfamily HESPERIINAE: *Ancyloxypha numitor* (Fabricius), V.21, 28; VI.3, 12; VII.11 to IX.9. *Hesperia metea* (Scudder), V.5 to 26; not common. *Hesperia attalus* (W. H. Edwards), form *seminole* (Scudder), VI.9; one female. This is the first record for Virginia. An earlier record (Proc. Biol. Soc. Washington **51**: 5. 1938) was based on a misidentification. A specimen quite similar to the one from Farmville was taken by the senior author at Clarks Gap, Loudoun County, IX.22.1940. Both specimens are now in the U. S. National Museum. *Hylephila phylaeus* (Drury); not found in 1940; VIII.30. 1939. *Atalopedes campestris* (Boisduval), V.31; VII.7 to IX.9. *Polites verna* (W. H. Edwards), VI.2; VIII.11, 18; in woods. *Polites manataaqua* (Harris), VI.2, 23; VIII.18; XI.1, 9; also V.29.1937. *Polites themistocles* (Latreille), V.26 to IX.10. *Polites peckius* (Kirby), VIII.18. *Wallengrenia otho egeremet* (Scudder), VII.30 to IX.1; also VI.13.1937. *Poanes zabulon* (Boisduval and LeConte), V.15 to VI.2; VIII.11 to IX.1. *Atrytone ruricola* (Boisduval), VI.30; VIII.11, 18. *Atrytonopsis hianna* (Scudder), V.12 to VI.2; in waste fields. *Amblyscirtes vialis* (W. H. Edwards), V.17, 26; VI.6; VIII.11. *Lerodea l'herminier* (Latreille), VI.9, 23; VIII.11 to IX.8; also V.27.1938.